

WHAT IS CLAIMED IS:

1. A scanning optical apparatus comprising:  
incident optical means for causing at least one  
light beam emitted from light source means to be  
5 incident on deflection means; and  
image formation means including at least one  
refractive optical element and at least one diffraction  
optical element for imaging said at least one light  
beam reflected and deflected by the deflection means on  
10 a surface to be scanned,  
wherein the diffraction optical element has at  
least one of an incident surface having a convex shape  
in a sub-scanning cross-section facing the deflection  
means and an exit surface having a convex shape in the  
15 sub-scanning cross-section facing the surface to be  
scanned.
2. An apparatus according to Claim 1,  
wherein a diffraction grating is formed on one  
20 of the incident surface and the exit surface of said  
diffraction optical element.
3. An apparatus according to Claim 1  
wherein said image formation means comprises a  
25 single refractive optical element and a single  
diffraction optical element and satisfies:  
$$0.5 < |e_2/s_1|$$

where  $e_2$  is a distance between an exit surface of the refractive optical element on an optical axis and the incident surface of the diffraction optical element on the optical axis, and

5             $s_1$  is a distance between the incident surface of the diffraction optical element on the optical axis and a front focus position of the diffraction optical element in the sub-scanning cross-section.

10           4. An apparatus according to Claim 1,  
             wherein the refractive optical element has a meniscus shape in a main scanning cross-section such that a concave surface faces the deflection means.

15           5. An apparatus according to Claim 1,  
             wherein a front focus position of the diffraction optical element in the sub-scanning cross-section is provided between a power arrangement in the sub-scanning cross-section of an on-axis refractive  
20           optical element and a power arrangement in the sub-scanning cross-section of an off-axis refractive optical element, in an optical axis direction.

             6. An apparatus according to Claim 1 further  
25           comprising:

             at least one of tilt adjusting means and shift adjusting means for adjusting a position of said

diffraction optical element.

7. An image forming apparatus comprising:  
a scanning optical apparatus according to any  
5 one of Claims 1 to 6;  
a photosensitive member arranged on the surface  
to be scanned;  
a developing member for developing an  
electrostatic latent image formed on the photosensitive  
10 member by the light beam scanned by said scanning  
optical apparatus as a toner image;  
a transfer member for transferring the  
developed toner image onto a material to be  
transferred;  
15 a fixing member for fixing the transferred  
toner image on the material to be transferred; and  
a printer controller for converting code data  
inputted from an external device into an image signal  
and inputs the image signal into said scanning optical  
20 apparatus.

8. An image forming apparatus comprising:  
a plurality of scanning optical apparatuses  
according to any one of Claims 1 to 6,  
25 wherein a color image is formed by guiding a  
plurality of light beams emitted from the respective  
scanning optical apparatuses onto a plurality of

corresponding image bearing member surfaces,  
respectively, and scanning the plurality of image  
bearing member surfaces with the plurality of light  
beams.

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9. A scanning optical apparatus comprising:  
incident optical means for causing at least one  
light beam emitted from light source means to be  
incident on deflection means; and

10 image formation means including at least one  
refractive optical element and at least one diffraction  
optical element for imaging said at least one light  
beam reflected and deflected by the deflection means on  
a surface to be scanned,

15 wherein the following condition is satisfied:

$$0.5 < |e2/s1| < 1.2$$

where e2 represents a distance between an exit  
surface of the refractive optical element on an optical  
axis and an incident surface of the diffraction optical  
20 element on the optical axis, and

s1 represents a distance between the incident  
surface of the diffraction optical element on the  
optical axis and a front focus position of the  
diffraction optical element in a sub-scanning cross-  
25 section.

10. An apparatus according to Claim 9,

wherein the diffraction optical element has at least one of an incident surface having a convex shape in a sub-scanning cross-section facing the deflection means and an exit surface having a convex shape in the sub-scanning cross-section facing the surface to be scanned.

11. An apparatus according to Claim 9,  
wherein a diffraction grating is formed on one of the incident surface and the exit surface of said diffraction optical element.

12. An apparatus according to Claim 9,  
wherein the refractive optical element has a meniscus shape in a main scanning cross-section such that a concave surface faces the deflection means.

13. An apparatus according to Claim 9,  
wherein the front focus position of the diffraction optical element in the sub-scanning cross-section is provided between a power arrangement in the sub-scanning cross-section of an on-axis refractive optical element and a power arrangement in the sub-scanning cross-section of an off-axis refractive optical element, in an optical axis direction.

14. An apparatus according to Claim 9 further

comprising:

at least one of tilt adjusting means and shift adjusting means for adjusting a position of said diffraction optical element.

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15. An apparatus according to Claim 9, wherein the following condition is satisfied:

$$0.55 < |e_2/s_1| < 1.1$$

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16. An image forming apparatus comprising:

a scanning optical apparatus according to any one of Claims 9 to 15;

a photosensitive member arranged on the surface to be scanned;

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a developing member for developing an electrostatic latent image formed on the photosensitive member by the light beam scanned by said scanning optical apparatus as a toner image;

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a transfer member for transferring the developed toner image onto a material to be transferred;

a fixing member that fixes the transferred toner image on the material to be transferred; and

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a printer controller for converting code data inputted from an external device into an image signal and inputs the image signal into said scanning optical apparatus.

17. An image forming apparatus comprising:  
a plurality of scanning optical apparatuses  
according to any one of Claims 9 to 15;

wherein a color image is formed by guiding a  
5 plurality of light beams emitted from the respective  
scanning optical apparatuses onto a plurality of  
corresponding image bearing member surfaces,  
respectively, and scanning the plurality of image  
bearing member surfaces with the plurality of light  
10 beams.